Quasi-three-dimensional photonic crystal defect microcavity

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We use the 3-D finite difference time domain (FDTD) method to analyze micro-pillar microcavities based on distributed Bragg reflectors (DBR) and more sophisticated structures consisting of quasi-3D photonic crystal defects. The aim is to produce low modal volume high Q cavities. The micro-pillar microcavity is modelled on III-V semiconductor materials (AlAs/GaAs) with quarter wavelength period stacks resonant at 994 nm wavelength. For small diameter pillars the quality factor Q of the cavity is reduced by light scattering from the sidewalls. Hence we look at microcavities including lateral 2D photonic crystals to suppress sidewall leakage. We input a few-cycle excitation pulse at the cavity centre then monitor the cavity ringdown using a probe above the pillar. From this we obtain the resonant frequencies and estimates of Q-factors ($Q=\lambda/\Delta\lambda$). The effective cavity volume V_{eff} can also be estimated. We calculate improved Q/V_{eff} values for photonic crystal defect microcavities.

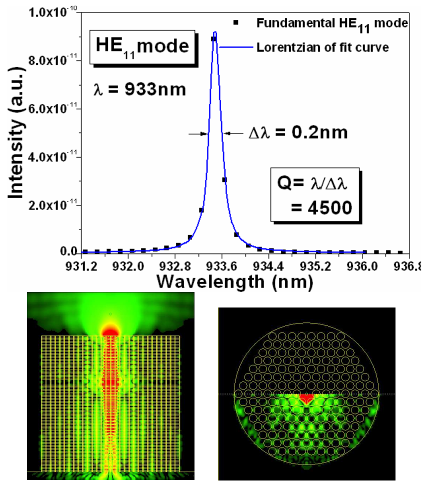

Fig. 1: Resonance and E-field in a photonic crystal microcavity.